```
In[1]:= (*5章4節 図5. 4の計算. 図5.4はBickleyの論文からの引用だが,
         実際には以下のRohdeの論文からも計算可能. *)

In[2]:= (*Rohde の論文の計算*)

In[3]:= (*Rohde,F.V.,Large deflections of a cantilever beam with a uniformly
                        大きい
        disributed load,Quart.,Appl.Math., 11(1953),p.337.*)

In[4]:= (*この結果をもとに変形図(Fig5-4)を描く*)

In[5]:= Clear["Global`*"]
        クリア

In[6]:= (*級数項の上限*)

In[7]:= nn = 12

Out[7]= 12

In[8]:= (*\theta の級数和の表現式*)

In[9]:= tht = 0;
        Do[tht = tht + a[i] * s^i, {i, 0, nn}]
        反復指定

In[11]:= tht

Out[11]= a[0] + s a[1] + s^2 a[2] + s^3 a[3] + s^4 a[4] + s^5 a[5] +
          s^6 a[6] + s^7 a[7] + s^8 a[8] + s^9 a[9] + s^10 a[10] + s^11 a[11] + s^12 a[12]

In[12]:= T = tht /. {a[0] → 0, a[1] → 0}

Out[12]= s^2 a[2] + s^3 a[3] + s^4 a[4] + s^5 a[5] + s^6 a[6] +
          s^7 a[7] + s^8 a[8] + s^9 a[9] + s^10 a[10] + s^11 a[11] + s^12 a[12]

In[13]:= (*Governing equation*)

In[14]:= eq1 = D[tht, {s, 2}] + w * s / EI * (Cos[alp] * Cos[T] - Sin[alp] * Sin[T])
                 微分係数                          余弦        余弦      正弦        正弦
```

$$2a[2]+6s\,a[3]+12s^2a[4]+20s^3a[5]+30s^4a[6]+42s^5a[7]+56s^6a[8]+72s^7a[9]+90s^8a[10]+110s^9a[11]+132s^{10}a[12]+\frac{1}{EI}s\,w\Big(\mathrm{Cos}[alp]\,\mathrm{Cos}\big[s^2a[2]+s^3a[3]+s^4a[4]+s^5a[5]+s^6a[6]+s^7a[7]+s^8a[8]+s^9a[9]+s^{10}a[10]+s^{11}a[11]+s^{12}a[12]\big]-\mathrm{Sin}[alp]\,\mathrm{Sin}\big[s^2a[2]+s^3a[3]+s^4a[4]+s^5a[5]+s^6a[6]+s^7a[7]+s^8a[8]+s^9a[9]+s^{10}a[10]+s^{11}a[11]+s^{12}a[12]\big]\Big)$$

(Out[14]=)

```
In[15]:= (*s のべき級数へ展開*)
```

In[16]:=
```
eq2 = FullSimplify[Series[eq1, {s, 0, nn}]]
```
完全に簡約　級数展開

Out[16]=

$$2\,a[2] + \left(6\,a[3] + \frac{w\,\mathrm{Cos}[alp]}{EI}\right) s + 12\,a[4]\,s^2 + \left(20\,a[5] - \frac{w\,a[2]\,\mathrm{Sin}[alp]}{EI}\right) s^3 +$$

$$\left(30\,a[6] - \frac{w\,a[3]\,\mathrm{Sin}[alp]}{EI}\right) s^4 + \left(42\,a[7] - \frac{w\,\left(a[2]^2\,\mathrm{Cos}[alp] + 2\,a[4]\,\mathrm{Sin}[alp]\right)}{2\,EI}\right) s^5 +$$

$$\left(56\,a[8] - \frac{w\,\left(a[2]\,a[3]\,\mathrm{Cos}[alp] + a[5]\,\mathrm{Sin}[alp]\right)}{EI}\right) s^6 + \frac{1}{6\,EI}$$

$$\left(432\,EI\,a[9] - 3\,w\,\left(a[3]^2 + 2\,a[2]\,a[4]\right)\mathrm{Cos}[alp] + w\,\left(a[2]^3 - 6\,a[6]\right)\mathrm{Sin}[alp]\right) s^7 + \frac{1}{2\,EI}$$

$$\left(180\,EI\,a[10] - 2\,w\,(a[3]\,a[4] + a[2]\,a[5])\,\mathrm{Cos}[alp] + w\,\left(a[2]^2\,a[3] - 2\,a[7]\right)\mathrm{Sin}[alp]\right) s^8 +$$

$$\frac{1}{24\,EI}\left(2640\,EI\,a[11] + w\,\left(a[2]^4 - 12\,\left(a[4]^2 + 2\,a[3]\,a[5]\right) - 24\,a[2]\,a[6]\right)\mathrm{Cos}[alp] +\right.$$

$$\left. 12\,w\,\left(a[2]\,\left(a[3]^2 + a[2]\,a[4]\right) - 2\,a[8]\right)\mathrm{Sin}[alp]\right) s^9 + \frac{1}{6\,EI}$$

$$\left(792\,EI\,a[12] + w\,\left(-6\,a[4]\,a[5] + a[3]\,\left(a[2]^3 - 6\,a[6]\right) - 6\,a[2]\,a[7]\right)\mathrm{Cos}[alp] +\right.$$

$$\left. w\,\left(a[3]^3 + 6\,a[2]\,a[3]\,a[4] + 3\,a[2]^2\,a[5] - 6\,a[9]\right)\mathrm{Sin}[alp]\right) s^{10} + \frac{1}{120\,EI}$$

$$\left(10\,w\,\left(3\,a[2]^2\,a[3]^2 + 2\,a[2]^3\,a[4] - 6\,\left(a[5]^2 + 2\,a[4]\,a[6] + 2\,a[3]\,a[7]\right) - 12\,a[2]\,a[8]\right)\right.$$

$$\mathrm{Cos}[alp] + w\,\left(-a[2]^5 + 60\,a[2]\,\left(a[4]^2 + 2\,a[3]\,a[5]\right) +\right.$$

$$\left.\left. 60\,a[2]^2\,a[6] + 60\,\left(a[3]^2\,a[4] - 2\,a[10]\right)\right)\mathrm{Sin}[alp]\right) s^{11} + \frac{1}{24\,EI}$$

$$\left(4\,w\,\left(3\,a[2]^2\,a[3]\,a[4] + a[2]^3\,a[5] - 6\,(a[5]\,a[6] + a[4]\,a[7] + a[3]\,a[8]) +\right.\right.$$

$$\left. a[2]\,\left(a[3]^3 - 6\,a[9]\right)\right)\mathrm{Cos}[alp] + w\,\left(-a[2]^4\,a[3] + 12\,a[3]\,\left(a[4]^2 + a[3]\,a[5]\right) +\right.$$

$$\left.\left. 24\,a[2]\,(a[4]\,a[5] + a[3]\,a[6]) + 12\,a[2]^2\,a[7] - 24\,a[11]\right)\mathrm{Sin}[alp]\right) s^{12} + O[s]^{13}$$

In[17]:=
```
(*展開項の確認*)
```

In[18]:=
```
eqs0 = Coefficient[eq2, s, 0]
```
係数

Out[18]= $2\,a[2]$

In[19]:=
```
eqs1 = Coefficient[eq2, s, 1]
```
係数

Out[19]=

$$6\,a[3] + \frac{w\,\mathrm{Cos}[alp]}{EI}$$

In[20]:=
```
eqs2 = Coefficient[eq2, s, 2]
```
係数

Out[20]= $12\,a[4]$

In[21]:=
```
eqs3 = Coefficient[eq2, s, 3]
```
係数

Out[21]=

$$20\,a[5] - \frac{w\,a[2]\,\mathrm{Sin}[alp]}{EI}$$

In[22]:= **eqs4 = Coefficient[eq2, s, 4]**
係数

Out[22]= $30\,a[6]-\frac{w\,a[3]\,\text{Sin}[alp]}{EI}$

In[23]:= **eqs5 = Coefficient[eq2, s, 5]**
係数

Out[23]= $42\,a[7]-\frac{w\left(a[2]^2\,\text{Cos}[alp]+2\,a[4]\,\text{Sin}[alp]\right)}{2\,EI}$

In[24]:= **eqs6 = Coefficient[eq2, s, 6]**
係数

Out[24]= $56\,a[8]-\frac{w\,(a[2]\,a[3]\,\text{Cos}[alp]+a[5]\,\text{Sin}[alp])}{EI}$

In[25]:= **(*s のべきごとに係数項を出力*)**

In[26]:=
```
Do[
反復指定
 eqs[i] = Coefficient[eq2, s, i];
          係数
 Print[i, " , ", eqs[i]], {i, 0, nn - 2}]
 出力表示
```

0 , $2\,a[2]$

1 , $6\,a[3]+\frac{w\,\text{Cos}[alp]}{EI}$

2 , $12\,a[4]$

3 , $20\,a[5]-\frac{w\,a[2]\,\text{Sin}[alp]}{EI}$

4 , $30\,a[6]-\frac{w\,a[3]\,\text{Sin}[alp]}{EI}$

5 , $42\,a[7]-\frac{w\left(a[2]^2\,\text{Cos}[alp]+2\,a[4]\,\text{Sin}[alp]\right)}{2\,EI}$

6 , $56\,a[8]-\frac{w\,(a[2]\,a[3]\,\text{Cos}[alp]+a[5]\,\text{Sin}[alp])}{EI}$

7 , $\frac{1}{6\,EI}\left(432\,EI\,a[9]-3\,w\left(a[3]^2+2\,a[2]\,a[4]\right)\text{Cos}[alp]+w\left(a[2]^3-6\,a[6]\right)\text{Sin}[alp]\right)$

8 , $\frac{1}{2\,EI}\left(180\,EI\,a[10]-2\,w\,(a[3]\,a[4]+a[2]\,a[5])\,\text{Cos}[alp]+w\left(a[2]^2\,a[3]-2\,a[7]\right)\text{Sin}[alp]\right)$

9 , $\frac{1}{24\,EI}\left(2640\,EI\,a[11]+w\left(a[2]^4-12\left(a[4]^2+2\,a[3]\,a[5]\right)-24\,a[2]\,a[6]\right)\text{Cos}[alp]+\right.$
$\left.12\,w\left(a[2]\left(a[3]^2+a[2]\,a[4]\right)-2\,a[8]\right)\text{Sin}[alp]\right)$

10 , $\frac{1}{6\,EI}\left(792\,EI\,a[12]+w\left(-6\,a[4]\,a[5]+a[3]\left(a[2]^3-6\,a[6]\right)-6\,a[2]\,a[7]\right)\text{Cos}[alp]+\right.$
$\left.w\left(a[3]^3+6\,a[2]\,a[3]\,a[4]+3\,a[2]^2\,a[5]-6\,a[9]\right)\text{Sin}[alp]\right)$

In[27]:= **(*連立方程式を解くためのリスト作成*)**

In[28]:=
```
eqlst = {}; anlst = {};
Do[eqlst = Append[eqlst, eqs[i] == 0];
  anlst = Append[anlst, a[i + 2]];
  , {i, 0, nn - 2}]
```
反復指定　追加　追加

In[30]:= `eqlst`

Out[30]=
$$\left\{2\,a[2]==0,\ 6\,a[3]+\frac{w\,\mathrm{Cos}[alp]}{EI}==0,\ 12\,a[4]==0,\ 20\,a[5]-\frac{w\,a[2]\,\mathrm{Sin}[alp]}{EI}==0,\right.$$
$$30\,a[6]-\frac{w\,a[3]\,\mathrm{Sin}[alp]}{EI}==0,\ 42\,a[7]-\frac{w\left(a[2]^2\,\mathrm{Cos}[alp]+2\,a[4]\,\mathrm{Sin}[alp]\right)}{2\,EI}==0,$$
$$56\,a[8]-\frac{w\,(a[2]\,a[3]\,\mathrm{Cos}[alp]+a[5]\,\mathrm{Sin}[alp])}{EI}==0,$$
$$\frac{1}{6\,EI}\left(432\,EI\,a[9]-3\,w\left(a[3]^2+2\,a[2]\,a[4]\right)\mathrm{Cos}[alp]+w\left(a[2]^3-6\,a[6]\right)\mathrm{Sin}[alp]\right)==0,\ \frac{1}{2\,EI}$$
$$\left(180\,EI\,a[10]-2\,w\,(a[3]\,a[4]+a[2]\,a[5])\,\mathrm{Cos}[alp]+w\left(a[2]^2\,a[3]-2\,a[7]\right)\mathrm{Sin}[alp]\right)==0,$$
$$\frac{1}{24\,EI}\left(2640\,EI\,a[11]+w\left(a[2]^4-12\left(a[4]^2+2\,a[3]\,a[5]\right)-24\,a[2]\,a[6]\right)\mathrm{Cos}[alp]+\right.$$
$$\left.12\,w\left(a[2]\left(a[3]^2+a[2]\,a[4]\right)-2\,a[8]\right)\mathrm{Sin}[alp]\right)==0,$$
$$\frac{1}{6\,EI}\left(792\,EI\,a[12]+w\left(-6\,a[4]\,a[5]+a[3]\left(a[2]^3-6\,a[6]\right)-6\,a[2]\,a[7]\right)\mathrm{Cos}[alp]+\right.$$
$$\left.\left.w\left(a[3]^3+6\,a[2]\,a[3]\,a[4]+3\,a[2]^2\,a[5]-6\,a[9]\right)\mathrm{Sin}[alp]\right)==0\right\}$$

In[31]:= `anlst`

Out[31]= {a[2], a[3], a[4], a[5], a[6], a[7], a[8], a[9], a[10], a[11], a[12]}

In[32]:= `(*連立方程式を解く*)`

In[33]:= `ans1 = Solve[eqlst, anlst][[1]]`
解く

Out[33]=
$$\left\{a[2]\to 0,\ a[3]\to -\frac{w\,\mathrm{Cos}[alp]}{6\,EI},\ a[4]\to 0,\ a[5]\to 0,\ a[6]\to -\frac{w^2\,\mathrm{Cos}[alp]\,\mathrm{Sin}[alp]}{180\,EI^2},\right.$$
$$a[7]\to 0,\ a[8]\to 0,\ a[9]\to \frac{w^3\,\mathrm{Cos}[alp]\left(5\,\mathrm{Cos}[alp]^2-2\,\mathrm{Sin}[alp]^2\right)}{25\,920\,EI^3},\ a[10]\to 0,$$
$$\left.a[11]\to 0,\ a[12]\to -\frac{w^4\,\mathrm{Sin}[alp]\left(-49\,\mathrm{Cos}[alp]^3+2\,\mathrm{Cos}[alp]\,\mathrm{Sin}[alp]^2\right)}{3\,421\,440\,EI^4}\right\}$$

In[34]:= `tht1 = (tht /. ans1) /. {a[0] → 0, a[1] → 0}`

Out[34]=
$$-\frac{s^3\,w\,\mathrm{Cos}[alp]}{6\,EI}-\frac{s^6\,w^2\,\mathrm{Cos}[alp]\,\mathrm{Sin}[alp]}{180\,EI^2}+\frac{s^9\,w^3\,\mathrm{Cos}[alp]\left(5\,\mathrm{Cos}[alp]^2-2\,\mathrm{Sin}[alp]^2\right)}{25\,920\,EI^3}-$$
$$\frac{s^{12}\,w^4\,\mathrm{Sin}[alp]\left(-49\,\mathrm{Cos}[alp]^3+2\,\mathrm{Cos}[alp]\,\mathrm{Sin}[alp]^2\right)}{3\,421\,440\,EI^4}$$

In[35]:= Series[Cos[tht1], {s, 0, nn - 1}]
級数展開 余弦

Out[35]= $1 - \frac{\left(w^2 \text{Cos}[alp]^2\right) s^6}{72\, EI^2} - \frac{\left(w^3 \text{Cos}[alp]^2 \text{Sin}[alp]\right) s^9}{1080\, EI^3} + O[s]^{12}$

In[36]:= (*級数展開*)

In[37]:= T1 = FullSimplify[Integrate[Series[Cos[tht1], {s, 0, nn}], {s, 0, s}]]
完全に簡約 積分 級数展開 余弦

Out[37]= $\frac{1}{35\,380\,800\, EI^4} s \left(35\,380\,800\, EI^4 + s^6 w^2 \text{Cos}[alp]^2 \left(-70\,200\, EI^2 + 7 s^6 w^2 (7 + 18 \text{Cos}[2\, alp]) - 3276\, EI\, s^3 w \text{Sin}[alp]\right)\right)$

In[38]:= Do[Print[i, " , ", Coefficient[T1, s, i]], {i, 1, nn}]
… 出力表示 係数

1 , 1

2 , 0

3 , 0

4 , 0

5 , 0

6 , 0

7 , $-\frac{w^2 \text{Cos}[alp]^2}{504\, EI^2}$

8 , 0

9 , 0

10 , $-\frac{w^3 \text{Cos}[alp]^2 \text{Sin}[alp]}{10\,800\, EI^3}$

11 , 0

12 , 0

In[39]:= T2 = FullSimplify[Integrate[Series[Sin[tht1], {s, 0, nn}], {s, 0, s}]]
完全に簡約 積分 級数展開 正弦

Out[39]= $\frac{1}{3\,113\,510\,400\, EI^4} s^4 w \text{Cos}[alp] \left(-129\,729\,600\, EI^3 + 6006\, EI\, s^6 w^2 (23 + 27 \text{Cos}[2\, alp]) - 2\,471\,040\, EI^2 s^3 w \text{Sin}[alp] + 35 s^9 w^3 (311 + 315 \text{Cos}[2\, alp]) \text{Sin}[alp]\right)$

In[40]:= Coefficient[T2, s, nn - 2]
係数

Out[40]= $\frac{w \text{Cos}[alp] \left(138\,138\, EI\, w^2 + 162\,162\, EI\, w^2 \text{Cos}[2\, alp]\right)}{3\,113\,510\,400\, EI^4}$

In[41]:= Do[Print[i, " , ", Coefficient[T2, s, i]], {i, 1, nn}]
… 出力表示 係数

1 , 0

2 , 0

3 , 0

4 , $-\frac{w\,Cos[alp]}{24\,EI}$

5 , 0

6 , 0

7 , $-\frac{w^2\,Cos[alp]\,Sin[alp]}{1260\,EI^2}$

8 , 0

9 , 0

10 , $\frac{w\,Cos[alp]\,(138138\,EI\,w^2 + 162162\,EI\,w^2\,Cos[2\,alp])}{3113510400\,EI^4}$

11 , 0

12 , 0

In[42]:= **defy1 = T1 * Sin[alp] + T2 * Cos[alp]**
正弦 余弦

Out[42]= $\frac{1}{3113510400\,EI^4} s^4\,w\,Cos[alp]^2 \left(-129729600\,EI^3 + 6006\,EI\,s^6\,w^2\,(23 + 27\,Cos[2\,alp]) - 2471040\,EI^2\,s^3\,w\,Sin[alp] + 35\,s^9\,w^3\,(311 + 315\,Cos[2\,alp])\,Sin[alp]\right) + \frac{1}{35380800\,EI^4} s\,Sin[alp]\,\left(35380800\,EI^4 + s^6\,w^2\,Cos[alp]^2\,\left(-70200\,EI^2 + 7\,s^6\,w^2\,(7 + 18\,Cos[2\,alp]) - 3276\,EI\,s^3\,w\,Sin[alp]\right)\right)$

In[43]:= **s * Coefficient[defy1, s, 1] + Coefficient[defy1, s, 4] * s^4**
係数 係数

Out[43]= $-\frac{s^4\,w\,Cos[alp]^2}{24\,EI} + s\,Sin[alp]$

In[44]:= **defx1 = T1 * Cos[alp] - T2 * Sin[alp]**
余弦 正弦

Out[44]= $-\frac{1}{3113510400\,EI^4} s^4\,w\,Cos[alp]\,Sin[alp]\,\left(-129729600\,EI^3 + 6006\,EI\,s^6\,w^2\,(23 + 27\,Cos[2\,alp]) - 2471040\,EI^2\,s^3\,w\,Sin[alp] + 35\,s^9\,w^3\,(311 + 315\,Cos[2\,alp])\,Sin[alp]\right) + \frac{1}{35380800\,EI^4} s\,Cos[alp]\,\left(35380800\,EI^4 + s^6\,w^2\,Cos[alp]^2\,\left(-70200\,EI^2 + 7\,s^6\,w^2\,(7 + 18\,Cos[2\,alp]) - 3276\,EI\,s^3\,w\,Sin[alp]\right)\right)$

In[45]:= **(*無次元化*)**

In[46]:= **defy2 = FullSimplify[((defy1) /. {w → EI * w1 / L^3, s → L * s1}) / L]**
完全に簡約

Out[46]= $\frac{1}{68428800}$ s1 (792 (s1^9 w1^3 (-1 + Cos[4 alp]) + 86400 Sin[alp]) +
s1^3 w1 Cos[alp]^2 (132 (-21600 + 23 s1^6 w1^2) + s1^3 w1 (-190080 Sin[alp] +
s1^3 w1 (3564 Cos[2 alp] + s1^3 w1 (91 Sin[alp] + 243 Sin[3 alp])))))

In[47]:= **defx2 = FullSimplify[((defx1) /. {w → EI * w1 / L^3, s → L * s1}) / L]**
完全に簡約

Out[47]= $\frac{1}{12454041600}$ s1 Cos[alp] (12454041600 - 7413120 s1^6 w1^2 + 8967 s1^{12} w1^4 +
7 s1^3 w1 (40 s1^3 w1 (-61776 + 109 s1^6 w1^2) Cos[2 alp] + 39 (1900800 Sin[alp] +
s1^6 w1^2 (81 s1^3 w1 Cos[4 alp] - 88 (47 + 51 Cos[2 alp]) Sin[alp]))))

In[48]:= **(* Deflections of the beam *)**

In[49]:= **(* Rohde's Paper equation (3)*)**

In[50]:= **alp1 = 0; Do[alp1 = alp1 - a[i] * L^i, {i, 3, nn}]**
反復指定

In[51]:= **alp1**

Out[51]= -L^3 a[3] - L^4 a[4] - L^5 a[5] - L^6 a[6] -
L^7 a[7] - L^8 a[8] - L^9 a[9] - L^{10} a[10] - L^{11} a[11] - L^{12} a[12]

In[52]:= **alp2 = FullSimplify[alp1 /. ans1]**
完全に簡約

Out[52]= $-\frac{1}{13685760 EI^4}$ L^3 w Cos[alp] (792 EI (-2880 EI^2 + L^6 w^2) +
1848 EI L^6 w^2 Cos[2 alp] + (-76032 EI^2 L^3 w + 43 L^9 w^3) Sin[alp] + 51 L^9 w^3 Sin[3 alp])

In[53]:= **(*Preparation of relation between alpha and w *)**

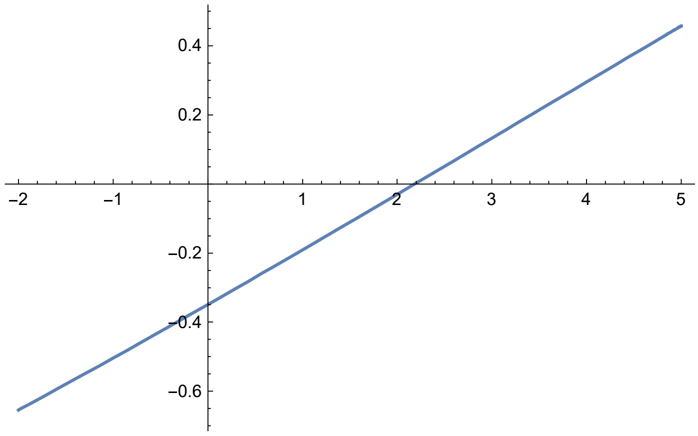
In[54]:= **alp3 = alp2 - alp**

Out[54]= -alp - $\frac{1}{13685760 EI^4}$ L^3 w Cos[alp] (792 EI (-2880 EI^2 + L^6 w^2) +
1848 EI L^6 w^2 Cos[2 alp] + (-76032 EI^2 L^3 w + 43 L^9 w^3) Sin[alp] + 51 L^9 w^3 Sin[3 alp])

In[55]:= **nonline1 = FullSimplify[(alp3) /. w → w1 * EI / L^3]**
完全に簡約

Out[55]= $\frac{1}{27371520}$ (-27371520 alp - 2 w1 Cos[alp] (792 (-2880 + w1^2) +
w1 (-76032 Sin[alp] + w1 (1848 Cos[2 alp] + 43 w1 Sin[alp] + 51 w1 Sin[3 alp]))))

In[56]:=
```
Plot[nonline1 /. alp → 20 * Pi / 180, {w1, -2, 5}]
```
プロット 円周率

Out[56]=


In[57]:=
```
FindRoot[nonline1 /. alp → 20 * Pi / 180, {w1, 0}]
```
根を求める 円周率

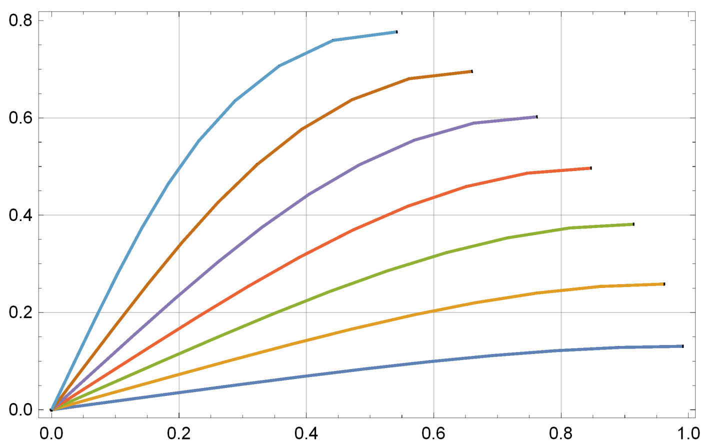
Out[57]= {w1 → 2.18506}

In[58]:=
```
(*alpha を与えてw1(無次元荷重)を求める*)
```

In[59]:=
```
Print["alpha      x/L         y/L "];
出力表示
deflst[1] = {};
deflst[2] = {};
deflst[3] = {};
deflst[4] = {};
deflst[5] = {};
deflst[6] = {};
deflst[7] = {};
Do[
反復指定
  alp1 = i * 10 * Pi / 180;
                  円周率
  answ1 = FindRoot[(nonline1 /. {alp → alp1}) == 0, {w1, 3}];(*Print[];
          根を求める                                          出力表示
   Print["alpha=",i*10,", w1=", answ1[[1]][[2]]]*);
   出力表示
   Do[
   反復指定
    s1 = (j - 1) / 10;
    defx3 = (defx2 /. answ1) /. {alp → alp1};
    defy3 = (defy2 /. answ1) /. {alp → alp1};
    deflst[i] = Append[deflst[i], {defx3, defy3}];
                追加
  If[s1 == 1, xt[i] = defx3];
  If文
  If[s1 == 1, yt[i] = defy3];
  If文
  (*Print[defx3,", ",defy3,","]*), {j, 1, 11, 1}
   出力表示
 ]
 , {i, 1, 7}]
(*結果のプロット*)
ListPlot[{deflst[1], deflst[2], deflst[3], deflst[4], deflst[5], deflst[6], deflst[7]},
リストプロット
 Frame → True, GridLines → Automatic, Joined → True]
        真      格子線        自動          点の結合   真
```

alpha   x/L   y/L

Out[62]=



In[63]:= (*座標原点(s=0)をはり先端にとっているためにこのような図になる*)

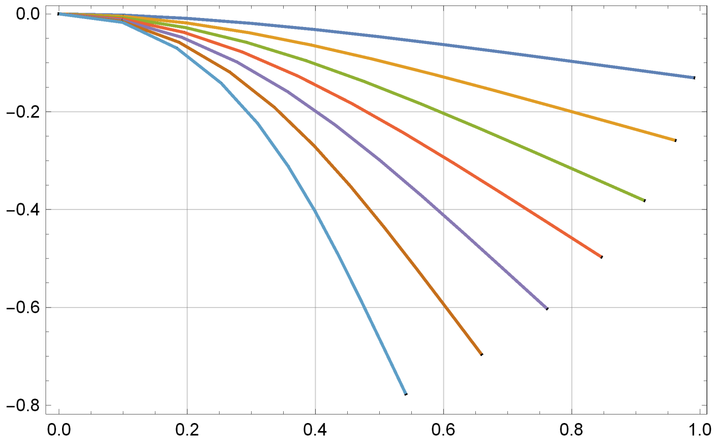
In[64]:= (*以下のような座標変換をする*)

In[65]:= (*リストのx座標を, xt[i]-x, y座標を, -yt[i]+yと変換する*)

In[66]:= (*ここで, xt[i],yt[i]は, はり固定端の変位(i番目の負荷荷重)*)

In[67]:=
```
Do[
反復指定
  deflst1[i] = {};
    Do[deflst1[i] = Append[deflst1[i],
    反復指定         追加
     {xt[i] - deflst[i][[j]][[1]], -yt[i] + deflst[i][[j]][[2]]}], {j, 1, 11}]
  , {i, 1, 7}];
ListPlot[{deflst1[1], deflst1[2], deflst1[3], deflst1[4], deflst1[5],
リストプロット
  deflst1[6], deflst1[7]}, Frame → True, GridLines → Automatic, Joined → True]
                           枠       真         格子線         自動           点の結合    真
```

Out[68]=



In[69]:=
```
Print["Deflection (x,y) "]
出力表示
Do[
反復指定
 Do[
 反復指定
  Print[deflst1[i][[j]][[1]], " , ", deflst1[i][[j]][[2]], " ,"], {j, 1, 11}]
  出力表示


 , {i, 1, 7}]
```

```
Deflection (x,y)
0.990221 , -0.130469 ,
0.891739 , -0.113108 ,
0.793247 , -0.0958073 ,
0.694718 , -0.0787206 ,
0.596108 , -0.0621048 ,
0.497362 , -0.0463211 ,
0.398418 , -0.0318357 ,
```

0.299218 , -0.0192222 ,
0.199729 , -0.00916398 ,
0.0999604 , -0.00245517 ,
0. , 0. ,
0.961015 , -0.258368 ,
0.867043 , -0.224174 ,
0.77303 , -0.190093 ,
0.678872 , -0.156414 ,
0.584401 , -0.123625 ,
0.489399 , -0.0924134 ,
0.393619 , -0.0636831 ,
0.296833 , -0.0385668 ,
0.198893 , -0.0184449 ,
0.0998324 , -0.00495845 ,
0. , 0. ,
0.912732 , -0.381198 ,
0.826123 , -0.331209 ,
0.739427 , -0.281371 ,
0.652421 , -0.232077 ,
0.564744 , -0.183989 ,
0.475921 , -0.138058 ,
0.385408 , -0.0955652 ,
0.292684 , -0.0581678 ,
0.197389 , -0.0279679 ,
0.0995622 , -0.00755773 ,
0. , 0. ,
0.84584 , -0.496518 ,
0.769225 , -0.432252 ,
0.692466 , -0.368157 ,
0.615197 , -0.30468 ,
0.536817 , -0.242583 ,
0.456524 , -0.182987 ,
0.373379 , -0.127453 ,
0.286439 , -0.0781076 ,
0.194996 , -0.0377945 ,
0.0990309 , -0.0102268 ,
0. , 0. ,
0.76093 , -0.601926 ,
0.696637 , -0.525333 ,

```
0.632142 , -0.448911 ,
0.566929 , -0.373101 ,
0.500147 , -0.298673 ,
0.430634 , -0.226799 ,
0.356982 , -0.159189 ,
0.277692 , -0.0983337 ,
0.191516 , -0.0478239 ,
0.0981962 , -0.0127502 ,
0. , 0. ,
0.658911 , -0.69534 ,
0.608893 , -0.608748 ,
0.558626 , -0.5223 ,
0.507469 , -0.436378 ,
0.454351 , -0.351656 ,
0.397773 , -0.269215 ,
0.335835 , -0.190742 ,
0.266354 , -0.118915 ,
0.187249 , -0.058011 ,
0.0975707 , -0.0148382 ,
0. , 0. ,
0.540942 , -0.776527 ,
0.50672 , -0.682565 ,
0.472229 , -0.588701 ,
0.436766 , -0.495202 ,
0.399144 , -0.402553 ,
0.357635 , -0.311589 ,
0.309911 , -0.223747 ,
0.253022 , -0.141598 ,
0.183625 , -0.0698483 ,
0.0989882 , -0.0172323 ,
0. , 0. ,
```